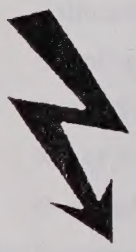
HIPOTRONICS®

THE MEASURE OF A LEADER

USER'S GUIDE

MODEL: KVM-200D
PART NUMBER: 45-125



DANGER!!

HIGH VOLTAGE!!

WARNING: This publication describes a product engineered and designed to measure or operate with HIGH VOLTAGES. Accordingly, maximum safeguards have been built into the equipment and the best safety techniques possible are described in the unit's operating instructions. These instructions caution the user to exercise great care when using certain controls at appropriate points in the operating procedures. In addition to following these written warnings, the operator of this equipment is strongly advised to maintain safety consciousness. The following rules are particularly relevant and must be followed at all times.

- BEFORE CONNECTING INPUT POWER, GROUND THE SYSTEM.
- BEFORE UN-GROUNDING THE SYSTEM, DISCONNECT POWER.
- NEVER APPROACH OR TOUCH A POTENTIALLY LIVE HIGH VOLTAGE CIRCUIT WITHOUT SOLIDLY CONNECTING AN APPROPRIATE GROUND CONDUCTOR FIRST.

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About the User's Guide

This user's guide describes functions and features of the HIPOTRONICS KVM Series of Digital AC/DC Kilovoltmeters. It is intended to provide a simplified reference for users of this equipment, allowing the quick, safe, and efficient use of the unit's features.

Specific information for the model purchased includes a diagram of the front panel, a parts list, and a schematic diagram.

Before You Begin

It is assumed that the user has a basic understanding of electrical equipment and the functions to be performed by this unit. ***Only trained, qualified personnel should operate this equipment.***

Organization of this User's Guide

This user's guide is divided into three major sections, including:

- **General Information**, which discusses the features and specifications of the models in the KVM Series and provides a description of the functions performed by each of the controls and indicators on the front panel.
- **Setting Up the Equipment**, which provides instructions for preparing the unit for test operations.
- **Operating the Equipment**, which provides instructions for performing test operations.

Related Publications

The functions, features, and specifications of the HIPOTRONICS KVM Series of Digital AC/DC Kilovoltmeters are discussed in Section 14 of HIPOTRONICS Product Catalog.

General Information

This section acquaints the user with the major features and specifications of the models in HIPOTRONICS' KVM Series of Digital AC/DC Kilovoltmeters and the functions performed by each of the controls and indicators on the front panel.

Features and Specifications

The models in the HIPOTRONICS KVM Series consist of a high voltage divider and a precision readout device. The 2-component, battery operated system can be broken down for field transport and use. All interconnecting and power cables are provided with the unit.

The parallel resistive/capacitive voltage divider is included with the unit. The divider's internal low voltage arm is designed to operate into an impedance of 1 megohm/50 pF. The divider is designed to be used with the supplied coaxial measurement cable and the supplied readout device, however an oscilloscope or a strip chart recorder may be used in place of the readout device.

The readout device is battery operated and includes its own charger. The many measurement modes offered by this device enable the user to easily read the various voltage waveforms.

Model: KVM-20

Readout Section	
Display	Digital, 3½ Digits, ½" LED Auto Polarity
Range	High - 0-19.99 kV, Low - 0-1.999 kV
Input	Impedance=1 megohm, Level=100 V F.S.
Accuracy	DC=±.5% of F.S., AV=±1% of F.S., RMS=±1% of F.S., Peak=±2% of F.S.
Power	Internal battery, 4 D-size Ni-Cad, External 115/230 V Operation 8 hours, Recharge 16 hours
Size	5" High x 10" Wide x 8½" Deep
Weight	5½ lb.
Divider Section	
Total HV Impedance	500 pF / 80 MΩ
HV Section Dim.	4½" Diameter x 9¼" High
Base Dimensions	N/A
Top Electrode	1" x 6" Diameter
Total Height	10"
Total Weight	8 lb.
Complete Assembly	High impact resistant plastic carrying case, removable top and bottom covers. Integral storage compartment.
Size	11" High x 11" Wide x 19¼" Deep
Weight	25½ lb.

Model: KVM-100

Readout Section	
Display	Digital, 3½ Digits, ½" LED Auto Polarity
Range	High - 0-99.9 kV, Low - 0-9.99 kV
Input	Impedance=1 megohm, Level=100 V F.S.
Accuracy	DC=±.5% of F.S., AV=±1% of F.S., RMS=±1% of F.S., Peak=±2% of F.S.
Power	Internal battery, 4 D-size Ni-Cad, External 115/230 V Operation 8 hours, Recharge 16 hours
Size	5" High x 10" Wide x 8½" Deep
Weight	5½ lb.
Divider Section	
Total HV Impedance	200 pF / 380 MΩ
HV Section Dim.	4½" Diameter x 13¼" High
Base Dimensions	N/A
Top Electrode	2" x 8" Diameter
Total Height	15"
Total Weight	12 lb.
Complete Assembly	High impact resistant plastic carrying case, removable top and bottom covers. Integral storage compartment.
Size	11" High x 11" Wide x 24⅜" Deep
Weight	35 lb.

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Model: KVM-200

Readout Section	
Display	Digital, 3½ Digits, ½" LED Auto Polarity
Range	High - 0-199.9 kV, Low - 0-19.99 kV
Input	Impedance=1 megohm, Level=100 V F.S.
Accuracy	DC=±.5% of F.S., AV=±1% of F.S., RMS=±1% of F.S., Peak=±2% of F.S.
Power	Internal battery, 4 D-size Ni-Cad. External 115/230 V Operation 8 hours, Recharge 16 hours
Size	5" High x 10" Wide x 8½" Deep
Weight	5½ lb.
Divider Section	
Total HV Impedance	200 pF / 760 MΩ
HV Section Dim.	4½" Diameter x 33¼" High
Base Dimensions	N/A
Top Electrode	3" x 8" Diameter
Total Height	38"
Total Weight	28 lb.
Complete Assembly	High impact resistant plastic carrying case, removable top and bottom covers. Integral storage compartment.
Size	11" High x 11" Wide x 45¾" Deep
Weight	45 lb.

Model: KVM-300

Readout Section	
Display	Digital, 3½ Digits, ½" LED Auto Polarity
Range	High - 0-300 kV, Low - 0-30.0 kV
Input	Impedance=1 megohm, Level=100 V F.S.
Accuracy	DC=±.5% of F.S., AV=±1% of F.S., RMS=±1% of F.S., Peak=±2% of F.S.
Power	Internal battery, 4 D-size Ni-Cad, External 115/230 V Operation 8 hours, Recharge 16 hours
Size	5" High x 10" Wide x 8½" Deep
Weight	5½ lb.
Divider Section	
Total HV Impedance	200 pF / 900 MΩ
HV Section Dim.	6" Diameter x 60½" High
Base Dimensions	12" High 24" Long (Legs)
Top Electrode	8½"x 34" Diameter (Double)
Total Height	84"
Total Weight	265 lb.

Model: **KVM-400**

Readout Section	
Display	Digital, 3½ Digits, ½" LED Auto Polarity
Range	High - 0-400 kV, Low - 0-40.0 kV
Input	Impedance=1 megohm, Level=100 V F.S.
Accuracy	DC=±.5% of F.S., AV=±1% of F.S., RMS=±1% of F.S., Peak=±2% of F.S.
Power	Internal battery, 4 D-size Ni-Cad, External 115/230 V Operation 8 hours, Recharge 16 hours
Size	5" High x 10" Wide x 8½" Deep
Weight	5½ lb.
Divider Section	
Total HV Impedance	200 pF / 1200 MΩ
HV Section Dim.	6" Diameter x 72½" High
Base Dimensions	24" High 36" Long (Legs)
Top Electrode	6"x 41" Diameter (Double)
Total Height	115"
Total Weight	285 lb.

Controls and Indicators

A diagram of the front panel for the KVM Series is displayed in Figure 1. Refer to this diagram, as well as to the front panel itself, when reading the description of the controls and indicators. ***Note that the front panel displayed in Figure 1 may differ slightly from that of the model purchased.***

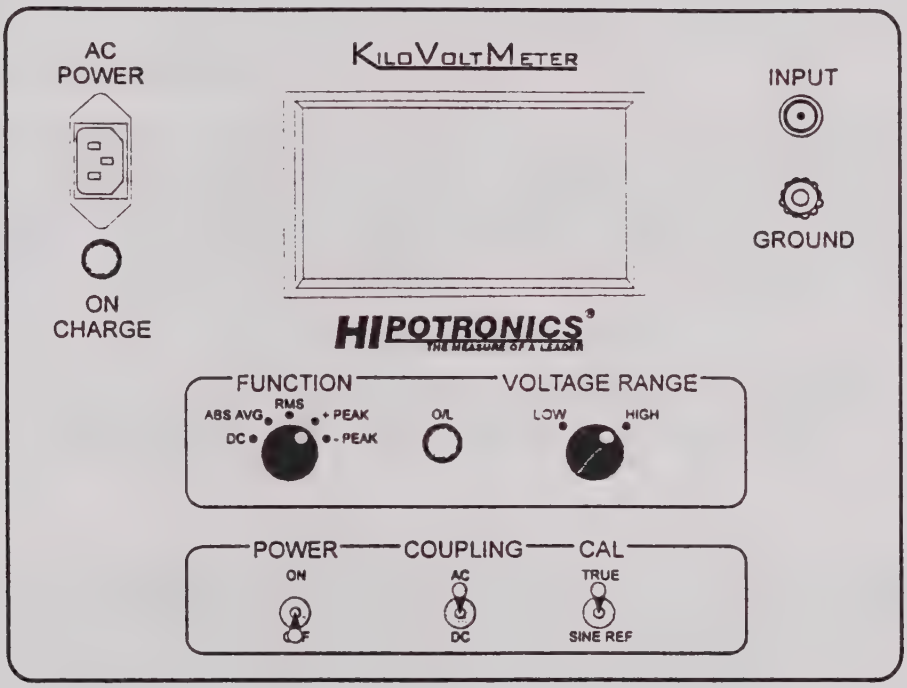


Figure 1 *KVM Series Front Panel*

DC Mode

The **DC** mode measures the average value of the direct current component of any voltage waveform. The digital meter automatically indicates the correct polarity and value. The **COUPLING** switch must be in the **DC** position to use this mode. The **AC** position inserts a blocking capacitor in series with the signal line to prevent measurement.

The signal source may be a time invariant dc level or a complex waveform that is time variant (unfiltered dc power supply). In either case, the indicated value is the average of the dc component over a period of ~ .2 seconds.

Absolute Average Mode

The **ABSOLUTE AVERAGE (ABS AVG)** mode rectifies the input waveform (takes the absolute value) and then averages this value. Most universal voltmeters use this technique. This is analogous to using a bridge rectifier and a dc meter to measure an ac waveform. This mode responds to both ac and dc components. The indicated value will be the algebraic sum of the average dc component plus the average value of the ac component in the dc coupling mode. The ac coupling mode removes the dc component.

Root Mean Square Mode (RMS)

RMS mode indicates the *true* rms value of any waveform. This is accomplished by means of a single integrated circuit that directly computes the rms value of a complex waveform. The converter will accurately convert signals with a maximum crest factor of five (peak value of five times the amplitude of the rms value). The rms value of a complex waveform with a dc component is the vector sum of the two components, for example:

$$\sqrt{(dc)^2 + (ac)^2}$$

The ac mode removes the dc component from the expression. All calculations are performed automatically. Note that there are no negative values in **RMS** mode.

Peak Mode

The **PEAK** mode (**Peak +, Peak -**) indicates the peak values of the waveform being measured. The **POSITIVE PEAK** mode captures the *highest* or most positive excursion of the waveform, although this may be a negative polarity. Conversely, the **NEGATIVE PEAK** mode captures the *lowest* or most negative excursion. The measurement interval is averaged over a relatively long time (5 seconds) to keep the error factor low.

Calibration (Absolute-Sine Reference)

This switch provides a means of converting between calculated values and real values of various waveform values. Most meters are calibrated in rms, but are not rms responding. Therefore, they measure in one mode and then have a conversion factor build in that relates to an rms value for a sine wave only. If the waveform is distorted or is not a sine function, errors will result.

In **SINE REF** position, the meter indicates the equivalent rms reading based on a sine wave value but measured with the selected function. In the **TRUE** position, the real value of that function is indicated. See Figure 2 for typical conversions.

Coupling Switch

This toggle switch controls the internal signal bus. In the **DC** position, there is a direct connection from the input to the measurement circuits. These circuits see the entire waveform to be measured (both ac and dc components). In the **AC** position, a blocking capacitor is inserted in the main signal path that blocks the dc component from the measurement circuits and allows only the ac components to be measured. This is useful when trying to evaluate each voltage component independently, such as the output of a power supply with a superimposed ripple. The ripple component may be separated from the average dc level.

Power Switch

This toggle switch controls the power to the main metering circuits. The meter digits light when power to the unit is ON. The unit uses nickel-cadmium batteries and is completely portable. This switch connects the batteries to the active metering circuitry. When the batteries are fully charged, the unit will operate for a total of eight hours before requiring a recharge. Recharging requires about 16 hours, with the unit plugged in and the power switch OFF. The **CHARGING** indicator lights when ac power is supplied to the charger circuits. The unit may be operated under ac power when batteries are low or when operating for extended periods of time.

Range Switch

A 2-position rotary switch selects the LOW or HIGH range of the meter. The decimal point moves automatically and always indicates a value in kilovolts. For maximum accuracy, use the largest reading or the highest deflection.

Overload Indicator

The Overload Indicator (**O/L**) flashes when the measuring circuits are overloaded and become non-linear. This is possible when measuring low duty cycle signals such as pulses. This indicates that the reading on the meter is not correct.

The meter range may accidentally exceeded, resulting in the lighted digits of the meter turning off (only the numeral 1 remains lighted). If this condition occurs, switch to a higher range or reduce the voltage to be measured.

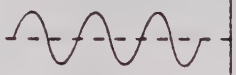
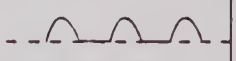
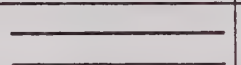
WAVEFORM			DC	|AV|	RMS	+PK	-PK
SINE	1 0 -1		0	.637	.707	+1	-1
RECT SINE	1 0		.637	.637	.707	+1	0
½ RECT SINE	1 0		.318	.318	.500	+1	0
TRIANGLE	1 0 -1		0	.500	.577	+1	-1
TRIANGLE	1 0		.500	.500	.577	+1	0
SQUARE	1 0 -1		0	1.000	1.000	+1	-1
SQUARE	1 0		.500	.500	.707	+1	0
DC	1 0		1	1	1	1	0

Figure 2 *Effective Waveform Values*

Effective Values of Various Waveforms

The factors displayed in Figure 2 are effective values for each ideal waveform, assuming a peak value of unity. To calculate a particular voltage, multiply the peak voltage of that waveform by its corresponding factor. This is done automatically by the readout device in the absolute (**ABS**) calibration mode.

The sine reference calibration mode (**SINE REF**) yields an effective RMS value based on a sine waveform. In this position, the readout will respond in the selected function but will be calibrated in rms.

Setting Up the Equipment

If the unit is supplied with a protective carrying case, (all KVM Series units up to 300 kV) all necessary parts and components are contained in the carrying case. To set up these units, do the following:

1. Place the carrying case on the floor in an upright position.
2. Open the four latches and remove the top cover to expose the readout device.
3. Pull the readout device out of the carrying case to expose the cable compartment. The cable compartment contains 25 feet of coaxial cable with a BNC-type connector for interconnecting the readout device and the divider assembly. Also supplied is a length of braided cable to be used as a ground lead for the divider and a power cord. The power cord allows the readout device to be plugged into an ac outlet for recharging the batteries.
4. Open the four bottom latches and lift the carrying case upward to expose the high voltage divider assembly. The divider should be clean and oil free.
5. Inspect the readout device for battery condition by turning the power ON. Meter digits should light and zero in a short time to within ± five counts. If the meter light level fades or does not zero, recharge the batteries with the power switch OFF (see the section of this user's guide titled *Charging the Internal Batteries*).

If the unit is *not* supplied with a protective carrying case, (all KVM Series units above 300 kV) the following sub-assemblies are included:

- A mobile tripod-style steel base
- A high voltage divider
- A digital readout package
- One set of interconnecting cables
- A top electrode double toroid assembly.

To assemble these units, do the following:

1. Place the base on a smooth, level surface.
2. Bolt the high voltage divider arm directly to the base, taking care to connect the low voltage side of the HV arm through the base. A single connection in the base is made from the low voltage arm to the low side of the HV arm. ***Ensure that the low voltage connection does not short out or no output readings will display on the digital meter.***
3. Attach the double toroid assembly to the top of the HV arm with the bolts provided.
4. Connect the coaxial cable between the divider base and the meter box.

5. Connect a solid ground to the divider base before operating the system.
6. Inspect the readout device for battery condition by turning the power ON. Meter digits should light and zero in a short time to within ± five counts. If the meter light level fades or does not zero, recharge the batteries with the power switch OFF (see the section of this user's guide titled *Charging the Internal Batteries*).

Charging the Internal Batteries

Connect the power cord to the readout device. Plug the power cord into an ac outlet. The **ON CHARGE** indicator lights. A full charge takes about 16 hours when the batteries are completely discharged. A full charge lasts for approximately 8 hours.

The batteries cannot be overcharged. The charger is self-limiting and can be left on indefinitely. Also, the unit may be operated with the charger on, allowing immediate use of the unit with low batteries and providing operation for longer than the 8 hour period.

If a unit is to be stored for any length of time, charge the batteries before storing. Leaving the batteries discharged for any length of time shortens their life. Always turn the power OFF when the unit is not in use or before storing.

Prior to performing these steps, the procedures described in the section of this user's guide titled *Setting Up the Equipment* must be performed. An area around the high voltage divider that is free from all conductive articles must be maintained. This area should have a radius in all directions equal to the height of the divider.

Voltage Measurement

1. Connect a low impedance ground lead to the ground connector at the base of the divider. Bolt the other end to a solid ground.
2. Connect one end of the coaxial interconnect lead to the signal connector at the base of the divider. Connect the other end to the readout device signal input.
3. For user safety, in case of a flashover, connect a ground lead from the readout device to a reliable ground.
4. Connect the high voltage between the top toroids on the divider assembly. The following minimum conductor sizes are recommended:

Voltage	Conductor
0-50 kV	10 mm
50-100 kV	25 mm
100-200 kV	50 mm
200-300 kV	75 mm
300-400 kV	Use 3" OD Pipe

5. Turn the readout device power ON and allow 5 minutes for stabilization. Apply high voltage and measure as needed using the front panel controls.
6. When measurements are complete, turn off the high voltage (verifying on the front panel meter). Manually discharge the high voltage point to ground and turn the meter OFF.

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